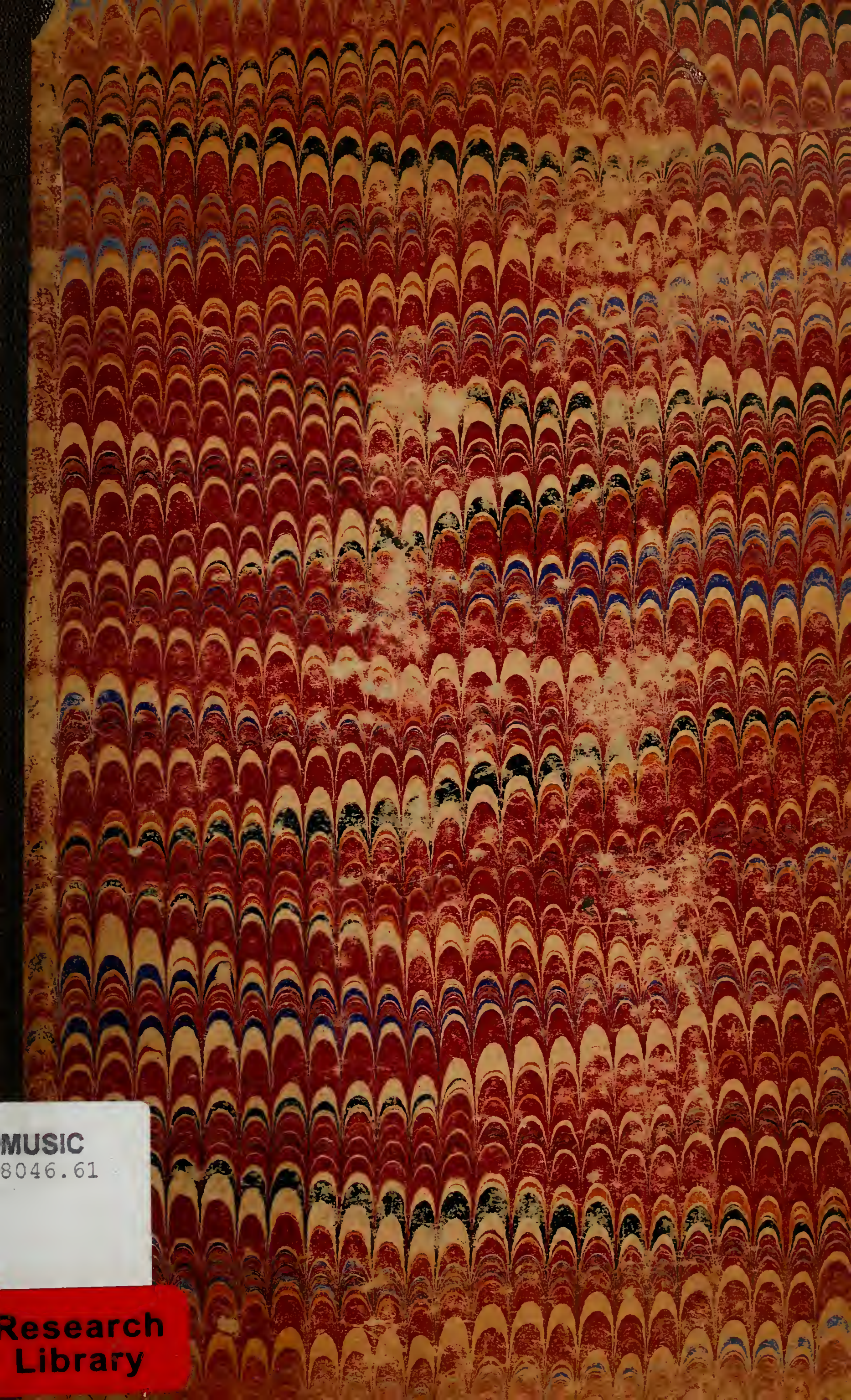

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ON THE PRESENT CONDITION
OF
MUSICAL PITCH IN BOSTON AND VICINITY.

By CHAS. R. CROSS and WM. T. MILLER.

Read before the American Association for the Advancement of Science.
Annual Meeting, August, 1880.)

(Reprinted from the American Journal of Otology, October, 1880.)

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PRESENT CONDITION OF MUSICAL PITCH IN BOSTON AND VICINITY.

The present paper contains an account of some measurements made at the Massachusetts Institute of Technology during the spring of the present year, in order to determine the amount of variation existing among the standard pitches used by different makers of musical instruments in the neighborhood of Boston.

The measurements were made by the method of beats, comparing the various standard forks with forks of a tonometer whose pitch had previously been determined with accuracy.

Not having a complete standard tonometer at our disposal, the following method was used. A standard C_3 fork, physical pitch, by König, had its number of vibrations per second determined by comparison with a standard fork possessed by the Stevens Institute of Technology, whose rate had been ascertained by Professor Mayer. This comparison I owe to the kindness of Professor B. F. Thomas. From this standard, by the method of beats, we determined the pitch of a C_3 fork by König, giving approximately the French pitch; and thence the pitch of a still sharper C_3 fork by the same maker, giving the Stuttgart pitch. Next above this, among the forks at our disposal, was a copy of Chickering's standard C_3 fork made by Mr. E. S. Ritchie of this city. The pitch of this was determined by comparison with the previously-named fork, and finally from this was obtained the number of vibrations of a high pitch C_3 fork of bell-metal made by Mr. Robert Spice, of Brooklyn. Between the sharpest and the flattest of these forks all the standards of pitch used in this neighborhood are included.

As a check upon measurements made with these forks, a tonometer of short range was constructed by tuning a series of the ordinary small C_4 forks used by musicians, so that each fork should give four beats per second (very approximately) with the one next lowest in pitch. The rate of these forks was also carefully determined by the method of beats, the fork No. 1 of this series being thus made an exact octave of König's German pitch C_3, and its number of vibrations verified by comparing it with the other forks tuned from it, and these with the various C_3 forks already mentioned. In all cases the pitches to be determined were compared with as many different forks as possible. The number of vibrations of the forks used is as follows:

1. Tonometer based on C_3.

König's physical pitch	256.13
" (approximate) French pitch	260.16
" German pitch	264.22
Ritchie's Chickering pitch	269.02
Spice's high pitch of New York	273.85

2. Tonometer based on C_4.

Fork No. 5	520.42
" " 4	524.38
" " 1	528.36
" " 2	532.30
" " 3	536.23
" " 6	540.15
" " 7	544.32

In the case of pitches based upon A instead of C, a tonometer was made from small musician's A_3 forks. The standards tuned from were forks made by König, viz., the 7th of the harmonic series based on C_2, which gives 896 vibrations per second, and the O fork of his vowel-series, claiming to give 448 vibrations per second. The rate given by König for these forks was assumed to be correct. This leaves room for a slight constant error in the results with the A forks, as the temperature at which the measurements were made was lower than that at which König in his recent paper in *Wiedemann's Annalen* (No. 3, 1880) has stated his older forks to be in exact accordance with the rate stamped upon them. The error would not amount to more than a tenth of a vibration, or thereabouts. The rate of the vowel-forks, which is not marked upon them, is that given to me verbally by the maker. Assuming the forks mentioned to be correct, the rates of the forks of the A tonometer were as follows:

No. 3	448.0
" 2	444.1
" 1	440.1
" 4	436.2

The C forks are not liable to the constant error mentioned, as the various forks were compared with each other at a temperature agreeing closely with that at which the rate of the standard C_3 was determined.

The intervals of time during which the beats were counted were estimated by means of a stop-watch, made by the Auburndale Watch Company, and known to the trade as the "Auburndale Timer." This reads to one-eighth seconds, and was found, notwithstanding its low cost, to be a very serviceable instrument for purposes of this nature. The rate of the watch was frequently determined, and a correction applied to the measurements of time.

The number of beats which could be counted was of course very different in different cases, varying with the quality and mass of the fork. Whenever the number of beats was small, on account of rapid diminution of intensity of the sound, great care was taken to make a number of sets of observations, and in almost all cases the results obtained rest upon a number of comparisons with different forks.

Notwithstanding its cheapness, the small C_4 tonometer was found to be very useful, and susceptible of sufficient accuracy for all practical purposes of determination of standards of pitch. In constructing such a tonometer the forks should be carefully selected, tested for duration of tone, and in tuning care should be taken to file away both prongs by as nearly the same amount as possible. To secure the forks from the change of pitch which might arise from heating by contact with the hand (which heating is of course far more rapid with these small forks than with the large ones generally used as standards), the handles should be mounted in cork. Care must be taken in doing this not to damp their vibration. If two small forks of the same mass and dimensions be compared when held in the naked fingers, and then when held in the cork handles, little or no difference of relative pitch will be noticed; but if one be held in the naked fingers, and the other protected, the effect of heating becomes evident. Hence this precaution of shielding the handle of the fork from the direct effect of the warm hand, is especially necessary when a large fork, which is but slightly and slowly affected thus, is compared with a small one, in which the effect is rapid and great. In our experiments this influence was carefully guarded against. Also with the small forks, which were sounded by percussion, the first few beats were not counted, to avoid any possible influence of excessive amplitude of vibration. In some cases we thought that we had observed an effect due to this, but could not assure ourselves that this was frequently the case.

The following table gives the results of our measurements. It will be seen to embrace a few pitches from other cities. The temperatures at which the comparisons were made were from 68° to 72° F. In the case of comparisons with pipes, the temperature is given in the table. The results after No. 9 are given in the order of their sharpness. Those measurements marked with an asterisk were made by Mr. Miller alone, the others by both the authors of this paper. The number of vibrations is given for C_3, but where C_4 forks or pipes have been measured in ascertaining the standard pitch, it is stated in column four.

In some cases considerable difficulty was experienced on account of the brief duration of the sound of the small forks used as standards by some makers. Nevertheless, the various repetitions and comparisons were carefully made, and the extreme difference of our results in different observations with forks is rarely over one-tenth of a vibration. When pipes were used larger differences were occasionally noticed.

A reference to the table shows that the lowest pitch at present used by any of the makers whose standards have been examined, is that of Messrs. Hutchings, Plaisted & Co., Church Organ builders, of this city (No. 11). Their pitch is identical with the German pitch, and has been adopted by them because, in their judgment, it is better adapted for choral purposes than is the extremely

TABLE.

No.	Designation.	No. of Vibrations.	Remarks.
		C_3	
1	König, physical pitch	256.1	Stamped 512 *v.s.*
2	König, French pitch (approximate)	260.2	Stamped 520 *v.s.*
3	König, German pitch	264.2	Stamped 528 *v.s.*
4	Ritchie, physical pitch	256.2	
5	König, physical pitch	256.2	Stamped 512 *v.s.*
6	Marloye, physical pitch	256.4	Made between 1845–50.
7	Ritchie	259.1*	Made about 1868.
8	Ritchie	259.4*	" "
9	Ritchie, copy of Chickering's standard	269.0	Made about 1868.
10	Mason & Hamlin, French pitch	259.1	Used for a few years only.
11	Hutchings, Plaisted & Co	264.0	Low organ pitch, C_4 fork measured.
12	Hook & Hastings, old flat organ pitch	264.6	C_4 pipe measured. Temperature, 69° F.
13	Organ in church of the Immaculate Conception, Boston	266.7	C_4 pipe measured. Temperature, 69° F.
14	Smith American Organ Co	267.2*	C_4 fork measured.
15	New England Organ Co	268.2	C_4 fork measured.
16	Chickering's standard fork	268.5*	C_3 fork, marked "1865, standard pitch."
17	H. F. Miller, pianos	268.9*	C_4 fork measured.
18	Mason & Hamlin, present standard pitch	269.0	C_3 fork, measured.
19	Fork of W. H. Clement, tuner	269.2	C_4 fork, measured.
20	George Woods & Co., cabinet organs	269.5	C_4 fork, measured.
21	Hook & Hastings, present standard pitch	270.0	C_3 and C_4 pipes measured. Temperature, 73°
22	Chickering piano used at Joseffy concerts, 1880	270.1	C_4 fork of tuner measured.
23	Covent Garden pitch, 1879	270.3	C_4 fork furnished by R. Spice.
24	Weber pianos	270.3	String of piano measured.
25	Thomas' pitch	271.1	C_4 fork furnished to builders of great Cincinnati organ.
26	Music Hall organ	271.2	C_3, principal, great. Temperature 70° F.
27	Steinway's pitch	272.2	C_4 fork furnished by R. Spice.
28	Highest New York pitch	273.9	C_3 fork furnished by R. Spice.
		A_3	
29	Nichols' fork, Boston, Germania orchestra	448	Corresponding to untempered C_3, 269.
30	Marloye's A fork	426	Imported by Prof. Lovering, 1845–'50.
31	Florence pitch, Marloye	438	" " "
32	Vienna pitch, Marloye	446	" " "
33	Milan pitch, Marloye	448	" " "

high pitch in common use in this country. It is substantially identified with No. 12, the old, flat pitch formerly used by Messrs. Hook and Hastings. The fork of the Smith American Organ Co., builders of Cabinet Organs (No. 14), lies between the German pitch and that of the Chickerings, and from this latter pitch (No. 16) the rise is gradual to the highest reached, No. 28. This is the pitch of a large C_3 bell-metal fork made a few years since by Robert Spice, of Brooklyn, and claiming to give the "9 P.M. concert pitch" of New York city. It is taken from a reed instrument used by Mr. Spice as a standard who remarks that he was obliged to raise the pitch after bringing it to this country from London, by about an eighth of a tone.

The pitch of the Steinway pianos, No. 27, was taken from a fork tuned for us by Mr. Spice. Its rate is a little lower than the number given by Mr. Ellis in his recent paper read before the Society of Arts, London. The fork, No. 23, giving the Covent Garden pitch, was also furnished by Mr. Spice, being tuned by him from a recently imported English concertina. The Steinway pitch is also stated by Mr. Spice to be identical with that of the New York Philharmonic Society, which is given by the oboe, a standard to which many musicians seem firmly attached, notwithstanding the manifest objections to using it instead of a fork. No. 24, Weber's piano pitch, was taken from a freshly-tuned piano in the wareroom of their agent in Boston, and hence may not represent the exact pitch used by the maker.

The fork A_3, No. 29, is the standard furnished by Mr. Nichols as that used by the Germania Orchestra of Boston. It is stated to be identical with that of the Boston Philharmonic Orchestra and the Harvard Musical Association. This gives 268.8 vibrations for an untempered C_3 on the same scale.

The remaining A_3 forks, a standard of Marloye's, and three forks made by him and giving the pitch in use at Florence, Vienna, and Milan, were imported by Professor Lovering between the years 1845 and 1850. The results of the measurement of these forks give for the pitch of Florence 438 vibrations; for that of Vienna, 446 vibrations; and for that of Milan, 448 vibrations.

In addition to these determinations of standard pitch, we have endeavored to obtain some information as to the manner in which the standards themselves were originally determined.

The standard fork at the Chickering's manufactory is a large C_3 fork, marked "1865, Standard Pitch," making 268.5 vibrations per second. The fork has its prongs inclined toward each other, which, as Scheibler has remarked, is objectionable in a standard fork, on account of variation of rate with amplitude. This is, however, not of much consequence if the fork is merely used for tuning instruments for sale. No facts could be ascertained regarding the maker of the fork, or the manner in which its pitch was determined, but the Messrs. Chickering state that it has the same pitch as the forks used by them before its construction. They also inform us that the standard of all their forks, is the standard pitch of the Philharmonic Society of New York, taken from the oboe, and in "perfect tune" with it. It will be noticed, however, by an inspection of the table, that the pitch of the Chickering 1865 standard is 268.5 vibrations, while that of the Steinways, also claimed as identical with the New York Philharmonic pitch, is, according to Mr. Spice's fork, 272.2 vibrations. Also the fork used in tuning for the Joseffy concerts (No. 22) gave for C_3 270.1 vibrations. These differences are quite noticeable, though less than those arising in the pitch of the oboe, which is so often taken as a standard by musicians. Mr. Miller also made an approximate measurement of an old C_4 fork used by the late Mr. Jonas Chickering, who gave it to the father of the gentleman now holding it, and who has had it in his possession for over twenty years. It was then supposed to represent the English concert pitch, but, as measured, gave only 522 vibrations per second, which corresponds to the French pitch.

As already remarked, the Chickering pianos, when used in the concert-room, are sometimes at least a little higher than their standard pitch. No. 22 is 1.1 vibrations sharper than No. 16, the standard, 1.6 vibrations flatter than the pitch of the Music Hall Organ at 70° F, and 2.1 vibrations flatter than the pitch of the Steinways. It is also very possible that the pitch of pianos in the concert-room may frequently be raised by the tuner a little above that of the fork carried by him, as it seems to be a frequent practice of tuners to tune a little sharp or a little flat, according to circumstances.

We have not been able to ascertain any facts regarding the origin of the pitch of the Messrs. Steinway beyond those already stated. Mr. Ellis, in the paper already referred to, gives a somewhat higher value (A_3=457 vibrations) than that found by ourselves.

The fork used at the manufactory of Mr. Henry F. Miller, of this city, for new pianos, is a small C_4 fork, giving 537.8 vibrations per second. A second C_4 fork, used by the same tuner for new pianos in houses, is about five vibrations per second flatter, and a third, which he uses for old pianos is a very close approximation to the French pitch. No. 19 is stated by Mr. Clement, the owner of the fork, to be of the exact pitch used by Messrs. Hallet & Davis for their pianos, and by Mr. Geo. H. Ryder for Church organs.

The standard used by Messrs. Mason & Hamlin for their cabinet organs is a large C_3 fork, giving 269 vibrations per second, and of the same shape and size as the Chickering 1865 standard. It has been used by the firm since 1866. At one time, when the Music Hall Organ was tuned to the French pitch, these makers tuned their cabinet organs to this low pitch, but instead of having a new fork manufactured, two thin weights of steel were made, which could be attached by wax to the ends of the prongs, so as to lower the pitch by the desired amount. The quantity of wax used in fastening these weights would of course perceptibly affect the rate of the fork. As given to us by the owners, the fork was a little flatter than the standard French pitch, giving 259.1 vibrations instead of 261 vibrations per second. It was stated to us that in New York complaint has been made of the present pitch of cabinet organs as too low, the higher Philharmonic pitch being taken as a standard. It is also said by various organ-builders that they have no desire to raise the present pitch, but that some manufacturers of pianos intentionally sharpen the pitch and desire all organ-builders to do the same.

Fork No. 20, the standard of Messrs. Geo. Woods & Co., makers of cabinet organs, is a small C_4 fork, copied in pitch from the fork of Mason & Hamlin, but an octave higher, and is slightly sharper than it. We are told by this firm, that they have frequently received complaints from cities abroad regarding the high pitch of their organs, the places particularly mentioned being Stockholm and Copenhagen. This might of course be expected in all places in which the French pitch is used as a standard.

The fork of the Smith American Organ Co. is a small C_4 fork, giving 534.4 vibrations per second. It is of quite low pitch and was originally obtained in 1866. Mr. Smith at that time tuned a fork to unison with one used by Signor Arditi, director of the orchestra of the opera company then performing in Boston, and has since used this pitch as a standard. The fork has been carefully preserved, twelve others having been copied from it for ordinary use. These facts given by Mr. Smith are also interesting as showing that in this city there has certainly been a decided variation in the pitch of the opera.

The standard of the New England Organ Co. is also a small C_4 fork.

The standard used by Messrs. Hook & Hastings is a C_4 metal pipe, which at a temperature of 73° gives 540 vibrations per second. This is probably about the pitch of their organs as used in churches, but in the concert-hall the pitch must rise very considerably above this. The same remark of course applies to all measurements of pipe organs, and in a less degree to reed organs. Though we have had no opportunity of actually ascertaining the fact by direct measurement, it is evident that the pitch of the Music Hall Organ must rise much above even the highest pitch given in our table. The standard pitch formerly used by Messrs. Hook & Hastings, in common with several other church organ-builders, was substantially identical with the German pitch. A C_4 metal pipe formerly used as a standard, and preserved by this firm, gave, at a temperature of 69°, 529.2 vibrations per second. Several of the organs of Messrs. Hook & Hastings, in this city, still remain tuned to this flat pitch. Among these Messrs. H. & H. mention the organs in St. Paul's Church, built in 1854, Church of the Unity (1859), Berkeley St. Congregational (1861), West Church (1861), Arlington St. Church (1861), Eighth Methodist (1861), Emmanuel (1862). In 1863, on building the organ for the Church of the Immaculate Conception, they raised the pitch to 533.4 vibrations per C_4, at 69° F., and at some time since a still further rise to their present pitch (540 vibrations for C_4, at 73°) has taken place. Among the larger organs by these makers, in this vicinity and elsewhere, tuned to this pitch, are those in Mechanics' Hall, Worcester (1864), South Congregational Church, Boston (1864), Plymouth Church, Brooklyn (1865), Cathedral, Boston (1875), and Tremont Temple, Boston (1880). The large organ built by Hook & Hastings for the Music Hall in Cincinnati, was tuned to a fork sent by Mr. Thomas for that purpose. This fork gives 542 vibrations per second, according to our measurements, which may also be taken as giving the pitch used by Thomas' Orchestra. The measurements of this fork (No. 25) were, however, less satisfactory than most of our measurements, as they were performed under somewhat distracting circumstances, and there is a liability to an error of as much as half a vibration in our result. The standard pitch of the Roosevelt Organ Co. is stated to be substantially the same as that of Messrs. Hook & Hastings.

Messrs. Hutchings, Plaisted & Co. use as a standard a small C_4 fork giving, as already remarked, the German pitch. Among the organs by these builders in this neighborhood and at this pitch, are those in St. John's Church, Roxbury; Old South Church, Boston; All Saints Church, Worcester, and Mr. Eugene Thayer's Studio Organ, Boston.

A few facts were also obtained with regard to the standard used by some of the makers of orchestral wind instruments.

The Quimby Bros., makers of brass wind instruments, tune by a cornet. The instruments are tuned a little sharp to allow for flattening in the band. Our observations were less accurate than we could desire, as we were obliged to make use of an ordinary watch instead of the stop-watch. The pitch was found, however, to be higher than that of Steinway's pianos. The liability to error in using such a standard is evident from the great degree in which the pitch of a cornet may be varied in blowing. A reed instrument used by another manufacturer can be varied as much as a quarter of a tone by variation in wind pressure. A reed (C_4) used by Mr. J. H. White gave (approximately) 538 vibrations per second, which is identical with Chickering's standard. This gentleman also informs us that he is obliged to raise the pitch of Boehm flutes, as made in New York, to be in unison with the concert pitch here, which he generally does by shortening the piece containing the mouth-hole.

A reference to the table will show that we have now in use in this city at least two distinct pitches, the low German pitch, found in those older organs which have not had their original pitch altered in retuning, and also now used entirely by Messrs. Hutchings, Plaisted & Co., and the high pitches used by the Messrs. Chickering, Hook & Hastings, and most others. There is, however, a very noticeable difference between the different high pitches, though there is such a gradual rise from the lowest to the highest that no separate grouping can be made. The difference between the pitch of the Music Hall Organ towards the middle of an evening concert, and that of a piano tuned to Chickering's pitch, would be greater than the difference between this last and the lowest pitch used in the city.

The organ in the Music Hall will naturally be considered as giving the standard pitch of the city of Boston. It is somewhat higher, however, than the orchestral pitch as given by the fork of Mr. Nichols (No. 29), and the difference would rapidly increase with a rise of temperature. This pitch has been used since 1871, at which date, on retuning the organ, the pitch was raised to its present value. During the years between the opening of the organ (1863) and 1871, it was at the French pitch, and this was consequently the standard for the oratorios and those concerts at which the organ was used. An attempt was also made to use the same low pitch in the symphony concerts, and for a while it was employed. The history of the pitch of the great organ is, however, so well known, that it need only be referred to here. The great cost of re-tuning the organ, even were there no other difficulty, renders it unlikely that any attempt to lower the present excessively high pitch will be made in this city for some time to come. It seems, however, much to be desired that we should follow the example of the majority of European nations in this respect. Especially is this important in the light of Mr. Ellis' recent proof (*Nature*, April 8, 1880), that not merely the works of Händel and Haydn, but those of all the founders of modern classical music, were written to a pitch (A_3, 423 vibrations, or thereabouts) considerably lower than the lowest orchestral pitch at present used in any country, lower even than the physical pitch. The present high pitch used in Boston, like that of New York and London, is over a diatonic semitone sharper than this classical pitch.

It is stated by Mr. P. J. Boris, of this city, that just after the Peace Jubilee of 1872, twenty different musicians united and gave to him as a standard of pitch a reed tuned by Mr. Smith, of the Smith American Organ Co. This was sent to France, and from it the instruments imported by Mr. Boris have been tuned. These are now complained of as being too flat, by four or five vibrations per second, an interesting fact, though much less conclusive in proving a rise in pitch than if a fork had been used as a standard.

With regard to standards used for scientific purposes, almost all such forks in the vicinity were made by König. The only others that have come to our notice, are one made by Marloye (No. 6) in the possession of Professor Lovering, of Harvard University, and those made by Messrs. E. S. Ritchie & Sons. The Messrs. Ritchie have made tuning-forks for scientific purposes for many years, and several of their forks have been measured by us. The standard at present used by them (No. 4) is identical with König's in pitch, but the owners do not recollect where it was originally obtained. It is not, however, one of König's forks. The first pitch used by them was between the physical and French pitches. Nos. 7 and 8 are two forks made by them about 1868. Afterwards their fork was compared with one by König, but they do not recollect that it was altered to correspond to this. Nevertheless, as the present standard is of the same form as the old forks, with the prongs bent toward each other at their extremities, there seems little doubt that the same fork was at some time lowered in pitch to correspond with König's standard. The fork was originally imported from Duboscq, and was very possibly originally made by Marloye, as it is similar in form to his pattern.

Another point made evident in our observations is, perhaps, worthy of notice. It is a familiar fact that a new fork, tuned accurately to unison with another, is, after a short interval, almost invariably found to be sharper than the fork from which it is copied. This is, of course, due to the heating of the fork in the process of filing, which tends to flatten it, and the subsequent rise in pitch upon cooling. That this has had any considerable influence upon the rise in pitch during the past century is doubtful, but that such a rise actually occurs among forks used by musicians, is shown by a comparison of the rates of certain forks measured by us.

The standard fork made for the Chickerings in 1865, has for its rate 268.5 vibrations per second. A copy of it, made for Mr. E. S. Ritchie in 1870, has the rate 269.0 vibrations, a rise of half of a complete vibration. Again, the standard Mason & Hamlin fork (No. 18) gives 269 vibrations, while the fork of the George Woods Organ Co. (No. 20), copied from Mason & Hamlin's standard, gives 539.1 vibrations, which for C_3 would be 269.5 vibrations; also a rise of half a vibration. If, as seems probable from their identity in shape and size, the standard of Mason & Hamlin is copied from that of the Chickerings, there is here still another instance of the same effect. The influence of such an effect as this would soon be noticed if several forks were tuned successively, each from the one below it in pitch.

It is a curious fact that with many musicians there is an idea that a fork is liable to change its pitch to a noticeable extent in course of time, while, as a matter of fact, it is well known to every student of acoustics that a fork properly used and kept is, after having recovered from the disturbances introduced in tuning it, practicably invariable in its rate under similar conditions. It seems to us that there are two ways in which the above-mentioned error may have originated. First, from the mistaken idea that since the oboe is so much less variable in its pitch than most orchestral instruments, under differences of blowing, etc., that it is really constant under all circumstances, something that can never be true of any vibrating column of air. If, then, forks are tuned by the oboe, considered as a standard, and subsequently compared with the same instrument, the pitch of the fork must appear to vary from time to time in a seemingly inexplicable manner. Secondly, it is very probable that forks have frequently been tuned to a definite pitch, and no attention paid to the sharpening which occurs on cooling, in which case the fork would seem to have varied in its rate, to one who was unfamiliar with the physical changes involved.

While engaged in these investigations an anomaly in our methods of tuning has frequently attracted our attention. In this country, as in England, it is customary to use C as a starting point in tuning pianos and organs, while A is universally taken as a starting point in the tuning of orchestral instruments. It is evident that when instruments tuned to the equally-tempered scale, with C as a basis, are played with others tuned to the tempered scale, with A as a basis, they can never be in tune with each other, as the effect of tempering will be different according to the temperament proceeds from C or from A. This is, of course, supposing that the A in question is a true major sixth of the C. If the A is a tempered sixth this statement will, evidently, not apply, so that if an orchestra tunes to the A of an equally-tempered organ instead of to an A fork or the A of the oboe, no difference of tune will arise from the cause stated, and hence our system, or rather want of system, is less objectionable than it would otherwise be. If the point is neglected, however, it adds a new source of confusion to the difficulties arising from our system of temperament and from the variation of pitch of wind instruments with the temperature and with the mode of sounding them; and additional duties are imposed upon the performers by requiring them to correct the variation by varying the tune of their individual instruments. It would certainly be more philosophical to tune all musical instruments from the same note as a base, either C or A, and it is very possible that it would be found to be of practical value. In Germany and France this is always done, but in this country the matter seems to be entirely overlooked.

As an instance of the trivial circumstances which frequently determine some of these matters, one of our best tuners of church organs told us that he formerly tuned from an A fork brought by him from Germany, but that he lost his fork, and bought a new one, which happened to be a C fork, and since then, without any greater reason, he had used C as a basis in all his work.

In conclusion, we would express our thanks to those manufacturers and others who have aided us by allowing us to measure their standards of pitch, as well as by favoring us with the information regarding the origin of these standards which we have stated in the preceding pages.

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